REMARKS

Claims 1-17 are pending in the present application. Claims 1 and 4 have been amended.

Information Disclosure Statement

An Information Disclosure Statement has been filed concurrently herewith. **The Examiner is respectfully requested to acknowledge receipt of the Information Disclosure Statement, and to confirm that the documents listed therein have been considered and will be cited of record in the present application.**

Claim Rejections-35 U.S.C. 103

Claims 1-17 have been rejected under 35 U.S.C. 103 as being unpatentable over the Okamoto reference (U.S. Patent No. 5,298,093) in view of SU 1148893 (abstract), the Corwin reference (U.S. Patent No. 4,735,771) or WO 01/57280. This rejection is respectfully traversed for the following reasons.

In the Response to Arguments Section beginning on page 4 of the Final Office Action dated September 21, 2007, the Examiner has asserted among other things that 1) none of the instant claims recite "large-size ingot" or "large-size product", 2) "large" is merely a relative term, which does not define any size, 3) none of the instant claims restricts formation of precipitation of sigma (σ) and khi (χ) phases, and 4) the Okamoto reference teaches to control sigma – and similar phases (column 2, lines 25-32).

Regarding the above noted first and second assertions by the Examiner, Applicants emphasize that the present invention is directed to increasing the production unit of thick cast products and hot working products in mass production or in industrial size applications. However, the concept of the present invention is also applicable to laboratory size of mother alloy. Also, Applicants concede that the term "large" is relative. However, these issues are secondary to the issue of patentability, as will be hereinafter demonstrated.

Regarding the above noted third assertion by the Examiner, independent claims 1 and 4 have been respectively amended to feature that the high-grade duplex stainless steel has high corrosion resistance, embrittlement resistance, castability and hot workability "which suppresses formation of intermetallic phases including sigma (σ) and khi (χ) phases...". Applicants emphasize that the high-grade duplex stainless steel of respective claims 1 and 4 are provided wherein formation of sigma (σ) and khi (χ) phases is suppressed.

Regarding the issue of suppressing formation of intermetallic phases in general, the Examiner has further asserted as noted above that the Okamoto reference teaches to control sigma and similar phases (column 2, lines 25-32). However, the Okamoto reference only discloses that the effect of W was investigated, and that it was found that W contributes to pitting resistance, but that formation of sigma and similar phases is negligible. That is, as described in column 3, lines 64 through to column 4, line 17 of the Okamoto reference, like Mo, W is effective for improvement in corrosion resistance

and particularly resistance to pitting corrosion. However, unlike Mo, W causes little acceleration of the formation of sigma and similar phases (please also see column 6, lines 1-36 of the Okamoto reference).

That is, the Okamoto reference only discloses that sigma and similar phases can be controlled by decreasing Mo and Cr with increasing W (see column 6, lines 27-30 of the Okamoto reference), because W has **little effect on acceleration of the formation of sigma and similar phases** due to its low rate of diffusion (please see column 4, lines 12-17 of the Okamoto reference).

Applicants emphasize that the present invention is directed to adding additional elements such as Ba (claim 1), and MM and/or Y (claim 4), which have a much larger atomic diameter than intermetallic phase formation elements such as Cr, Mo, Si and W, in order to actively suppress the formation of intermetallic phases, in which the alloying elements fill atomic vacancies in austenitic and ferritic phase-boundaries and crystal grains of ferritic phase, to block a diffusion path of the Cr, Mo, Si and W.

On page 4, paragraph 4 of the Final Office Action, the Examiner has asserted that W is not an essential element in any of the instant claims (claims 1 and 4). The Examiner has taken this position of record responsive to the quoted text reproduced by the Examiner on page 4, paragraph 4 of the Final Office Action. However, the quoted text included by the Examiner on page 4, paragraph 4 of the Final Office Action has been reproduced from page 10 of the Remarks section of the Amendment dated July 13, 2007. That is, the above noted quoted text in the Final Office Action was initially

reproduced by Applicants from the Okamoto reference in the Amendment dated July 13, 2007, to make the point that one of ordinary skill would not have been motivated by the Okamoto reference to improve hot workability by more fixing of S. It would appear that the Examiner has mistakenly attributed the quoted text reproduced on page 4, paragraph 4 of the Final Office Action as an admission by Applicants that W is critical. However, Applicants have not argued on pages 10-11 of the Amendment dated July 13, 2007, that W content is critical. The Examiner has misunderstood and has failed to appreciate the arguments as presented in the above noted Amendment dated July 13, 2007.

Applicants emphasize that in claims 1 and 4, W is one of the main intermetallic phase formation elements along with Cr, Mo and Si. However, claims 1 and 4 cover ranges wherein W is not added (0 to 6.5 % of W), and thus covers W-free specimens as in the examples. According to the present invention, additionally added Ba, MM and/or Y can actively suppress the formation of intermetallic phases under the above mentioned mechanism.

Responsive to the Examiner's comments on page 4, paragraph 5 of the Final Office Action, Applicants again emphasize that production yield of the cast products and hot working products increases because additionally added Ba, MM and/or Y actively suppress the formation of intermetallic phases under the above mentioned mechanism.

Upon comparing the corrosion resistance between the high-grade duplex

stainless steel of the present invention and that of the Okamoto reference, it should be understood that the examples in the Okamoto reference show inferior pitting potential when considered with respect to the present invention. That is, the Okamoto reference shows pitting potential results (mV vs. SCE) measured in an aqueous 20% NaCl solution at 80°C in Table 2 (refer to column 8, lines 54-60, and Table 2 of the Okamoto reference), whereas the present invention shows pitting potential results (mV vs. SCE) measured in a much more severe 0.5N HCl + 1.0N NaCl solution at 50°C and 70°C in Table 2 (refer to page 21, lines 4-8, and Table 2 of the present application). From these results, it should be understood that the high-grade duplex stainless steel of the present invention shows superior PREW values than that of the Okamoto reference, and also shows superior pitting potential. In Table 2 of the present application, it should be noted that "**2) Above equilibrium oxygen evolution potential: No pitting generated"** means above 858 mV vs. SCE, and that no pitting is generated in the specimen.

That is, no pitting is generated only in Alloy No. 7 of the Okamoto reference. In contrast, no pitting is generated in almost all alloy specimens as shown in Table 2 of the present application, because more PREW elements (Cr, Mo, W) can be added as compared to the Okamoto reference. The added Ba, MM and/or Y in the present invention actively suppress formation of intermetallic phases due to the increased contents of Cr, Mo, and W.

Applicants respectfully submit that the additionally cited SU 1148893 and

WO 01/57280 references do not provide disclosure regarding the roles of Ba, MM and/or Y to the formation of intermetallic phases. Since these references do not disclose the above noted roles of Ba, MM and/or Y, this rejection the combination of the secondary references is clearly based on impermissible hindsight.

Regarding the Examiner's comments on page 5, paragraph 1 of the Final Office Action, the SU 1148893 reference does not disclose or suggest problems and solutions of the intermetallic or secondary phases and corrosion resistance of stainless steel. One of ordinary skill in the art would thus obtain no teaching or motivation that Ba provides a mechanism for actively suppressing formation of intermetallic phases in view of this secondary reference.

Regarding the Corwin and WO 01/57280 references, Applicants emphasize that these references are not directed to steel itself, but rather to dopants or alloy added to molten steel. That is, these references are essentially directed to a ferroalloy. This refers to various alloys of iron with a high proportion of one or more other elements, such as manganese or silicon for example. Ferroalloys are used in the production of steels and alloys as a raw material. The main ferroalloys are FeMn and FeCr. These references are concerned with improving specific properties such as oxidation resistance or decreasing grain size, which has nothing to do with the formation of intermetallic phases. Thus, one skilled in the art would have no motivation to consider these references in an effort to suppress formation of intermetallic phases in duplex stainless steel.

Regarding the Examiner's comments on page 5, paragraph 2 of the Final Office Action, independent claims 1 and 4 recite suppressed formation of sigma (σ) and khi (χ) phases. As emphasized above, the Okamoto reference does not teach adding additional elements such as Ba, MM and/or Y to suppress formation of intermetallic phases.

Also, Applicants emphasize that the Corwin reference is essentially directed to dopants which can be added to iron-based alloy materials to dramatically improve their resistance to oxidation (refer to column 1, lines 48-55 of the Corwin reference). Even though the Corwin reference relates to dopants added to austenitic and ferritic ferrous alloys as a means of improving elevated temperature oxidation resistance as described in column 1, lines 5-11, the term "austenitic and ferritic ferrous alloys" does not indicate duplex stainless steel as asserted by the Examiner, but indicates austenitic stainless steel and ferritic stainless steel. In this regard, the Corwin reference only describes that the dopant may be employed in austenitic stainless steel, ferritic stainless steel and non-stainless steel (refer to column 6, lines 42-62 of the Corrwin reference).

Applicants emphasize that the dopant elements according to the Corwin reference, as ions, enter into the protective oxide scale outside the alloy matrix, greatly reducing the amount of oxidation observed due to elevated temperature exposure. In contrast, in the present invention, Ba, MM and/or Y exists as in an atomic state and oxide, or as in a compound state, inside the alloy matrix intervening with the combining action of Cr, Mo, Si and W, and thereby actively suppresses the formation of

intermetallic phases. The intervention cannot occur at alloy-scale or the scale-gas interface.

Responsive to the Examiner's comments on page 5, paragraph 3 of the Final Office Action, Applicants emphasize that the WO 01/57280 reference relates to a method for grain refining of steel, particularly ferritic and austenitic steels, i.e., duplex stainless steel. However, the WO 01/57280 reference is directed to only a material or ferroalloy added to molten or liquid steel as a small **auxiliary agent** in the tapping ladle in order to control the solidification structure. The auxiliary agent may be FeMn (ferromangamese) used as a deoxidizer for steel, for example. The WO 01/57280 reference does not disclose or suggest the formation of intermetallic phases in duplex stainless steel.

On page 5, paragraphs 3 and 4 of the Final Office Action, the Examiner has asserted that the teaching of REM in the Okamoto reference does not exclude mischmetal. Applicants however emphasize that as set forth in column 7, line 60 through to column 8, line 4 of the Okamoto reference, the addition of an excessive amount of the second group of elements (Ca, Mg, B, REM) results in the formation of oxides and sulfides of these elements in increased amounts, leading to a deterioration in corrosion resistance, since non-metallic inclusions such as oxides and sulfides serve as points at which pitting corrosion is initiated.

In contrast, as described on page 10, lines 8-15 of the present application, minute rare-earth metallic mixtures or Ba oxides could additionally block diffusion of Cr,

Mo, Si and W at a temperature ranging from 1000°C to 650°C, to lower a precipitation speed of intermetallic phases. MnS non-metallic inclusion was generally operated as a starting point of corrosion due to its lower corrosion resistance than a matrix, but rare-earth non-metallic inclusion was not operated as a starting point of corrosion due to its higher corrosion resistance than the matrix.

That is, the Okamoto reference considers REM only for improving the hot workability of duplex stainless steel, and its oxides and sulfides deteriorate the corrosion resistance (refer to column 7, line 34 through to column 8, line 3 of the Okamoto reference). However, in the present invention, MM and its non-metallic inclusion is actively used for suppressing the formation of intermetallic phases without sacrificing corrosion resistance of the matrix steel.

Applicants emphasize that the above noted finding is why the high-grade duplex stainless steel of claims 1 and 4 show extremely superior corrosion resistance as compared to the steels disclosed in the Okamoto reference as mentioned above. That is, Ba, MM and/or Y (and their oxides and sulfides, etc.) can actively suppress the formation of intermetallic phases even though much more intermetallic phase formation elements (Cr, Mo, Si or W) may be included.

Accordingly, Applicants respectfully submit that the high-grade duplex stainless steel of respective claims 1 and 4 would not have been obvious in view of the prior art as relied upon by the Examiner taken singularly or together, and that this rejection, insofar as it may pertain to claims 1-17, is improper for at least these reasons.

Conclusion

The Examiner is respectfully requested to reconsider and withdraw the corresponding rejection, and to pass the claims of the present application to issue, for at least the above reasons.

In the event that there are any outstanding matters remaining in the present application, please contact Andrew J. Telesz, Jr. (Reg. No. 33,581) at (571) 283-0720 in the Washington, D.C. area, to discuss these matters.

Pursuant to the provisions of 37 C.F.R. 1.17 and 1.136(a), the Applicants hereby petition for an extension of one (1) months to January 21, 2008, for the period in which to file a response to the outstanding Office Action. The required fee of $60.00 should be charged to Deposit Account No. 50-0238.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment for any additional fees that may be required, or credit any overpayment, to Deposit Account No. 50-0238.

Respectfully submitted,

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